

Evaluating Rapa Nui Prehistoric Terrestrial Resource Degradation

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THE NATIONAL SCIENCE FOUNDATION has recently funded a three year interdisciplinary project on Rapa Nui to investigate terrestrial resource dynamics. The research involves archaeologists (Stevenson, Haoa, Ladefoged, Mulrooney), an ecologist (Vitousek), a soil scientist (Chadwick), and a modeller (Puleston), and is addressing four questions: (1) Was there a pre-European contact crisis in agricultural food production on the island? (2) If so, where, when, and how did this crisis occur? (3) If not, how was one avoided and sustainable production maintained? and (4) Is pre-European contact collapse the best way to describe what happened to the natural environment and society of Rapa Nui? The research is evaluating the decline in island resource productivity by employing innovations in geochemistry, paleoclimatological reconstruction, chronometric dating, and eco-dynamic modelling. We are determining whether large-scale physical erosion occurred throughout the island using soil-stratigraphic observations and tracers of surface stability (isotopes of cesium and lead). We are also documenting whether soil nutrient levels declined (independent of soil erosion), or if they were enhanced through various natural and cultural mechanisms. Variations in ancient gardening techniques are being defined and their relative advantages and disadvantages are being assessed. Using obsidian hydration and radiocarbon dating, the research is establishing spatial and temporal patterning in the distribution of agricultural practices and associated settlement. These diverse strands of data are being integrated in a series of ecodynamic models. By establishing the linkages and relationships between the model variables, the research will determine the extent of environmental degradation and the impact that this had on terrestrial resource productivity and socio-political transformations.

The first season of fieldwork was completed in April 2010 and involved four activities:

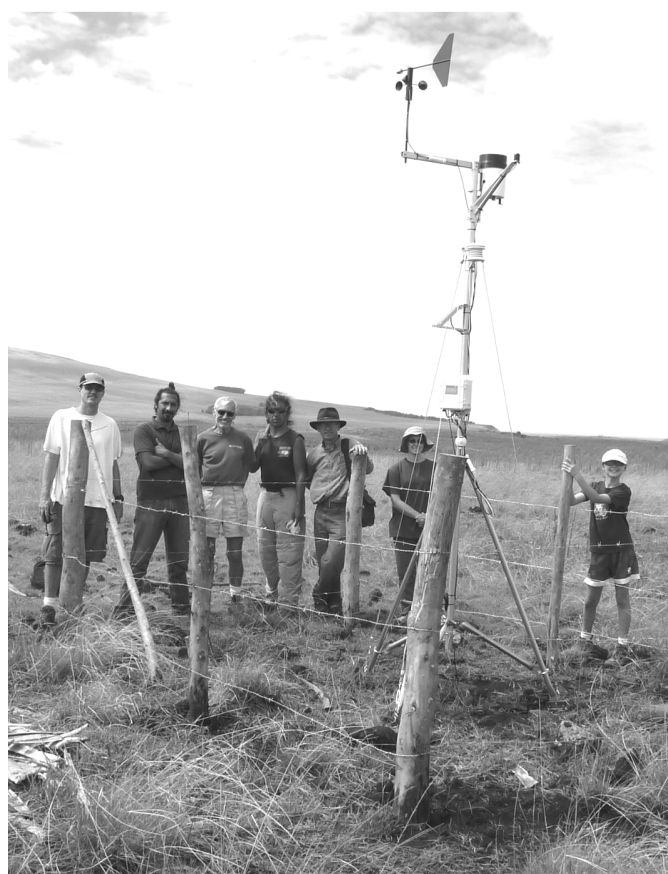
1) Surface Survey: The identification of prehistoric cultural features and their age assessments is being used to reconstruct ancient demographic patterns. The project will

investigate six 500m by 500m study areas. In April, work was done in three of these areas. The Vaitea survey area, located in the upland central portion of the island, had been originally surveyed in 1998. This year, we re-located each of the 70 archaeological features (e.g. house pavements, alignments, caves, terraces), recorded their locations using GPS technology, and excavated small shovel test pits near 30 of the features in order to collect subsurface obsidian samples for obsidian hydration dating. In Hivahiva, along the northwest coast, and near Maunga Anamarama, in the western interior of the island, we carried out a full coverage survey using GPS and mapped a range of agricultural and residential features.

- 2) Nutrient Soil Sampling: Our previous work on the island has established the importance of soil nutrient variation (Ladefoged et al. 2005, 2010) for agricultural activities (Stevenson et al. 2002, 2006). In April, we collected additional integrated (0-30cm below ground surface) and deep pit (0-210cm bgs) soil samples from garden and non-garden areas in Hivahiva, Vaitea, and Anamarama. The sampling strategy included collecting multiple samples from single gardens, as well as a series of samples to test the hypothesis that gardens were placed adjacent to basalt outcrops to take advantage of nutrient enrichment from long-term basalt weathering. A sampling transect was located between two outcrops separated by a distance of 50 meters and soil samples were taken at 1m intervals within rock garden contexts and at 3m intervals within stone-free areas. All of these samples will help us document soil nutrient dynamics associated with gardening activities in various environmental settings.
- 3) Installation of Meteorological Stations: Stand alone weather stations were established to monitor environmental conditions around the island. The data from the stations will help us to understand the influence of climatic conditions on crop production and soil nutrients. Six HOBO weather stations were shipped from the USA to Rapa Nui where they were assembled, tested, and then

installed in the field. The stations were placed at six locations across the island at different elevations (near the summit of Terevaka 540m; interior 280m; south coast 140m; north coast 40m; eastern interior 90m; west coast 65m). Each station was equipped with sensors to monitor wind speed and direction, solar intensity, rainfall amount, temperature, relative humidity, atmospheric pressure, and soil moisture (25cm below surface). The data is currently being logged on stand-alone computers that are downloaded monthly.

- 4) Placement of Soil Temperature Sensors: Ground temperature is critical in this project for two reasons. First, it will be used to adjust calibrations for the obsidian hydration dating of archaeological features. Second, it will show the thermal differences between soil growing environments within and outside of rock gardens. HOBO Pendant temperature data loggers were retrieved from two locations buried in 2009 and four new sets were installed at locations near the weather stations. Sensors were buried in an open location and in an adjacent rock garden to compare the thermal differences of each context. At each location the sensors were buried at depths of 10, 25 and 50cm below ground surface. They will be retrieved and downloaded after the 365 day annual cycle.



The NSF group with one of the meteorological stations.

Over the next two years, we will build on our initial fieldwork and refine our research strategies. By integrating diverse data sets and analysing them in rigorous ways we hope to gain a comprehensive understanding of the development of intensified agricultural systems and their proposed degradation over time. It is hoped that this research may contribute to the resolution of the much publicized debate over whether or not the pre-contact Rapanui people destroyed their environmental resources and entered into a downward spiral of anarchistic doom.

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